Vermont Lake and Watershed Action Plans

Technical Guidelines for Conducting a LWAP

Issues and Objectives; Methods and Assessments; Process; and Reporting

December 2022

Vermont Department of Environmental Conservation
Agency of Natural Resources
Watershed Management Division
1 National Life Drive, Main 3
Montpelier VT 05620-3522
www.watershedmanagement.vt.gov

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION
LAKES & PONDS PROGRAM

Table of Contents

1. The Purpose of a Lake Watershed Action Plan

A Lake Watershed Action Plan (LWAP) is an assessment and planning tool that identifies the greatest threats to the lake ecosystem. LWAPs are designed to identify and communicate the problems and solutions within a lake watershed to best protect water quality, wildlife habitat, and the lake's ecosystem health. These plans answer the questions "what issues threaten the health of our lake the most?" and "what can we do about them?"

A Watershed is…
All the land area that drains to a common body of water, like streams and runoff from all the land uses in the area draining to Coles Pond, pictured below, in Jamaica, VT.

Why Conduct a LWAP?

According to a U.S. Environmental Protection Agency (USEPA) study of lakes across the country, the health of Vermont's lakes has been measured to be lower than both the northeast region and the national average in terms of percent of shoreland that is either in fair or poor condition, as measured by the extent of clearing, lawns, and development near the shoreline. When a lake's natural vegetation is removed and replaced by lawns and impervious surfaces fish and wildlife habitat degrades, shores erode, nutrient loading to the lake increases. These factors make the lake is more vulnerable to water quality problems such as algae blooms. Cleared shores are also more susceptible to erosion during flood events.

In addition to the threats from shoreland development, lakes receive stormwater runoff from other land uses in the watershed, including roadways. Each lake has its own set of public roads, private roads, and driveways and how these are managed will have an influence on the lake's condition. The LWAP will determine the extent of impact from road systems on lake water quality and highlight the stretches in most need for improvement to reduce erosion and runoff.

Another source of potential pollutants into the lake is through tributary flow and loading of phosphorus and sediment into a lake which can fuel aquatic plant beds, negatively impact recreational use, and lead to increases in a lake's nutrient levels, which in turn can lead to algal blooms. A greater understanding of the tributaries of concern will be determined through a LWAP and planning can occur to mitigate any identified issues.

Ultimately, the purpose of a LWAP is to provide clear guidance on the steps for protecting a lake and its watershed and maintaining or improving its current condition. When a lake's ecosystem is healthy, then lake residents can enjoy and benefit from all the existing uses they are accustomed to in these water bodies, such as recreation, aquatic habitat, and aesthetic conditions.

Anticipated Outcomes

LWAPs are designed to answer specific concerns about each lake, for example, what land uses within the watershed cause the greatest stress to a lake ecosystem. Each lake has different land use patterns and understanding exactly which ones are causing degradation to the lake will help guide restoration and protection efforts. The LWAP assesses and compares the varying land uses and provides a ranking of the greatest threats to the lake along with recommendations for fixing the problems. A LWAP combines an

assessment of a lake's shoreland, tributaries, and hydrologically connected roads and leads to an individual planning guide that prioritizes restoration and protection actions for that lake. A LWAP can also help identify cumulative impacts on a lake ecosystem, thereby helping lake stakeholders "see the bigger picture" and identify situations where the combination of individual stressors may be leading to declines in lake health.

A LWAP is an investigation into potential threats to the lake's ecosystem health, and the process should be participatory with the lake association or similar local organizations, lake users, shoreland owners, the Town, and other stakeholders or interested groups and people. A LWAP Final Report will also include a list of prioritized problems and solutions as well as provide a table of projects. This prioritized list of projects and strategies is intended to address the sources of pollution and habitat degradation identified in the assessment, with some of these projects benefitting from preliminary ecological and conceptual design work as part of the LWAP development process. The prioritized list of projects can feed into the DEC Watershed Projects Database and be considered for funding under the Clean Water Initiative Program (CWIP) and other sources. Given CWIP's focus on meeting water quality restoration targets, often contained in Total Maximum Daily Load (TMDL) Phosphorus Reduction Plans, a project must have a primary objective of water quality improvement if is to be considered for CWIP funding. The LWAP may also contain recommendations to preserve natural features and functions of a lake and its watershed, encourage use of low impact green stormwater infrastructure, and maintain the aesthetic and recreational uses of lakes.


Lake Sunrise, Orwell

2. Objectives

Four Main Objectives

1. Produce a report based on a survey of a lake's watershed that identifies the primary sources of water quality and habitat degradation impacting the lake condition, including the health of the shoreland buffer and sources of phosphorus and sediment loading to the lake. The LWAP Report will include a ranking of the greatest threats to a lake and best solutions to mitigate the issues.

2. Involve community members in learning how they are the most essential solution for clean and healthy lakes. In most watersheds, more than 85 percent of land is privately owned and without public participation in the LWAP process, few solutions can be applied without private property participation.

The LWAP GOAL

The goal of a LWAP is to evaluate water quality conditions and related stressors in a lake and its watershed to identify the greatest threats to the lake ecosystem, including sources of increased stormwater runoff and associated sediment and nutrients as well as other important stressors such as invasive species, habitat loss, erosion, and other threats that may lead to loss or degradation of defined uses under the Vermont Water Quality Standards.

3. Within the report, provide a map with an estimate of relative sediment and phosphorus load from each of the primary "sectors" of a lake's watershed into the lake. The LWAP should strive to utilize existing load estimates if available from an existing study or TMDL.

4. Identify and Prioritize at least 30 projects, including shoreland BMPs, that can be implemented in the lake watershed to address lake stressors. Prioritize these projects using evaluation criteria based on: relative phosphorus loading; water quality benefits; project feasibility; maintenance requirements; costs; and any additional benefits. Create conceptual designs (roughly 30% design) for a number of priority projects, identified in the contract.

Examples previous LWAPs can be found on the Lakes and Ponds Program website.

3. Process – Tasks and Deliverables

Essential Elements to Conducting a LWAP

1. **Assemble a Team**. From the start, this effort needs local interest and support, and the process must be participatory, led jointly a lake association with input from town conservation or planning commission; conservation partners (Conservation Districts or River Associations), State Agency expertise and possible funding; consulting expertise; and other concerned parties.
    - With your team, create a detailed workplan and timeline.
    - Hold a public "kick off" meeting and invite all local stakeholders to review the workplan. You will need to provide meeting minutes as a deliverable.
    - If necessary, some steps may require subcontracting which will require you to provide of a statement of reasoning for the contractor selection as a deliverable.
2. **Office Preparation**. Use GIS and other spatial analysis tools, like the ANR Atlas and LiDAR imagery, VTDEC water quality data, and other resources to gather existing information about land uses and water quality conditions in the watershed. This will help to define and describe the watershed and to guide your field survey work.
    - Create a watershed data library that includes a reference section. Maps and spatial analysis of potential field assessment site

LWAP Approach Uses Scientific Method

1. Ask a Question
For most LWAPs, the question being asked is "what are the greatest threats to the health of the lake ecosystem, including degrading water quality and wildlife habitat?"

2. Design Methods
- Collect and compile existing monitoring data, GIS and other spatial data information on land use, climate, and topography.
- Conduct field surveys along the shoreland, roadways and tributaries.

Assessments should identify sources of stormwater pollution and the land uses that cause or contribute to stormwater pollution and wildlife habitat loss.

3. Tally Results
The results of the study should answer the initial question – what are the biggest threats to the lake ecosystem? – and identify projects that can be implemented to address these problems.

4. Analysis and Communication
Communication is essential to the success of these plans. The more public engagement and participation throughout the LWAP process, the more anticipation for hearing the results. Action steps should be clearly and publicly conveyed from the results of the LWAP.

locations, segmented road network, and hydrologically connected road segments.

- Create an ANR Atlas Locator Map of the watershed. Locator maps need to be submitted for each project identified under an assessment or planning grant. Locator maps must be created using the ANR Atlas Clean Water Initiative Program Grant Screening Layer (http://anrmaps.vermont.gov/websites/anra5//), which identifies potential natural resource conflicts and permitting needs for a given area. Project locator maps should be downloaded from the Atlas for each project identified in the LWAP, and the maps should be submitted to DEC as a PDF. Please see the CWIP Application Manual, Appendix 1, for instructions on how to create project locator maps, available at: https://dec.vermont.gov/sites/dec/files/wsm/erp/docs/manual_appendix1.pdf
- Sources of data may include: Vermont ANR Mapping, VCGI Open Data Portal, existing municipal road assessment/survey information, current Lake Scorecard Data, Next Generation Lake Assessments, NRCS Soil data, Vermont Open Geodata Portal, National Hydrologic Dataset, Vermont DEC, Vermont Fish and Wildlife, UVM Spatial Analysis Lab, VTrans, LaRosa Sampling Data, Lake Wise Data

3. **Field Assessments.** Under the Methods Section of this Technical Guideline for LWAPs, three core areas of assessment are expected, and more details are provided there for conducting field work.
   - **Shoreland Assessments:** Complete a Shoreland Assessment and Lake Wise Assessments. A Shoreland Assessment is a boat tour of the entire shoreline, or strategically prioritized sections of the shoreline. Lake Wise Assessments are done on shoreland properties with the permission of the landowner. A certain number of these assessments is prescribed in your contract. To perform Lake Wise Assessments, you must attend a Lake Wise Assessment Training, or reach out to DEC's Lakes and Ponds Lake Shoreland Coordinator for training. You must use the Lake Wise Application to perform Lake Wise assessments.
     - Produce locator maps with site photos of identified problems and a project summary report that identifies site/design considerations, permitting needs, cost estimates, restoration/water quality improvement objectives and goals, and level of landowner commitment.
   - **Roadway Assessments:** Decide on an approach for assessing roadways. This could draw from the Municipal Roads General Permit (MRGP) road erosion inventory methodology for municipal roads and/or adopt the MRGP inventory with DEC approval for non-municipal road networks. Ground truth your inventory of hydrologically connected roads from your watershed data library, prioritizing those that do not meet the standards of the MRGP erosion inventory and those identified through local knowledge as problematic.
     - Create a locator map with site photos of potential improvement projects.
     - Create a project summary report that identifies the site/design considerations, permitting needs, and best management practices necessary to bring road segments into compliance, associated costs estimates, and level of landowner commitment.
   - **Stream Assessments:** Identify all tributaries to the lake and create a method for reach prioritization using existing monitoring data and local knowledge. All tributaries should be assessed to some extent. Complete an SGA Lite Assessment (Phase 2 Rapid Stream Assessment) or Stream Wise Assessments where appropriate (see methods section for descriptions of each).

        - Create locator maps with site photos of identified problems
        - Create a project summary report that includes site/design considerations, permitting needs, cost estimates, restoration/water quality improvement objectives, and level of landowner commitment for each project.
    - **Project Prioritization:** Develop a criterion for project prioritization of clean water projects. Apply these criteria to all projects identified during the field portion of the LWAP. The criteria used to prioritize the projects as well as the ranking of projects should be reviewed at a public meeting with stakeholders.
        - Create data visualization of relative sediment and phosphorus load from each of the primary "sectors" of a lake's watershed into the lake
        - Provide a report with a list of criteria used for prioritization, a table with data showing greatest threats to the lake by sector, and a list of prioritized projects that includes the level of landowner commitment to move forward for each project.
        - Include meeting minutes from the stakeholder prioritization meeting.
    - **Restoration Plans:** Create 30% concept designs for top prioritized projects. Number of projects will be identified in your contract agreement.
        - Designs for prioritized projects will include a synthesis of any prior completed applicable deliverables, 30% design, written landowner commitment to the next project step, and refined permitting requirements and cost-estimates.
    - **Final Reports:** LWAP reports will be drafted and shared with the LWAP team for review and at least one round of edits. Examples of completed LWAPs are available here. The final LWAP report will include:
        - a high-level overview/synthesis of all the prior completed deliverables
        - a batch import file of projects ((BIF Excel https://dec.vermont.gov/water-investment/cwi/grants/resources)
        - a locator map of all projects identified.
        - A public presentation of the outcomes of the LWAP is required and that presentation will be recorded and made available on the DEC website as well as the Lake Association Website.
        - Informational "library" used for LWAP as an appendix.

Reporting

Different funding sources may have different reporting requirements. In the past, LWAPs in Vermont have been funded privately by lake associations, with DEC CWIP funding, and by the Lake Champlain Basin Program (LCBP). Reporting on the use of funds by funding recipients is an important aspect of accountability, and DEC has established milestones and deliverables based on project type for all CWIP funding initiatives, which are included in the scope of work of all grant and contract agreements. LCBP grant agreements may also include some unique reporting requirements, and to ensure consistency across LWAP development in Vermont as well as eligibility for subsequent project implementation funding, these LWAP Technical Guidelines include some required deliverables that actors developing LWAPs should strive to complete. Consistency in LWAP deliverables allows for comparison of broad-based lake issues and solutions, the level of pollution to lakes, and the means for comparing success of LWAPs over time, and these required deliverables provide consistent outcomes for all LWAPs regardless of the funding source.

LWAP Milestones and Deliverables

The previous section laid out the expected tasks and deliverables for LWAPs. These are adapted from Appendix B of the Clean Water Initiative Program SFY2023 Funding Policy. These milestones and deliverables are subject to change periodically, and it is therefor the responsibility of grantees to confirm with their grantor that they are following the current requirements.

- **Clean Water Initiative Funding:** The VTDEC provides funding for a range of clean water projects. These funds are administered under the Clean Water Initiative Program. To fully understand the funding opportunities and how they track the phosphorus loading and clean-up efforts throughout Vermont waters, visit their web site for updated information.

- **CWIP funding of Lake Watershed Action Plans has several requirements.** These are important to understand, especially for Final Reporting. https://dec.vermont.gov/water-investment/cwi/grants/resources

4. Field Methodology

Each LWAP analysis should include three core field assessments:

- Shoreland
- Roadways
- Tributaries

To evaluate these lake watershed areas, the methods involve review of electronic data and tools for watershed pre-assessment followed by on site field visit evaluations. (See the **Process** section above for information about the required outcomes of the electronic data review and suggested resources for this preparatory work.) Below is the methodology for performing the required Field Assessments.

Shoreland Assessment

Boat Around the Shore

Shorelands can be miles long and boating along the lake and observing the shore for obvious issues of erosion, excessive clearing, or road runoff can help identify problem shoreland and shallow water habitat areas in a time efficient way.

Many lake association members or other lake users would be willing to provide boat rides, and this teamwork helps fuel local participation and engagement in the LWAP process. Even if you have your own boat, it is recommended that the boat tour include someone very familiar with the lake and the lake community to help identify landowners and known problem areas.

Shoreland assessments look at private and public property as well as lake side road issues, and tributaries. The purpose of the boat tour is a holistic look at how the land use around the lakeshore is affecting the health of the lake and beginning to identify where the biggest problem areas might be.

- Before going into the field, study aerial maps to identify potential locations to look at, prioritizing public beaches, public boat access areas, tributaries, areas with cleared land to the water, any active agriculture or forestry areas.
- Bring a map and GPS enabled device to be able to mark locations for further investigation.
- Take photos of potential project areas.

Lake Wise Assessments

From both the boat tour and the initial kick-off meeting you may have already identified shoreland areas that are potential problem sites. A Lake Wise Assessment should be performed on these shoreland sites. Lake Wise Assessments provide a prioritized list of recommendations for each property assessed. Lake Wise Assessments for LWAPs should prioritize those properties that have both willing landowners and highest priority projects. Properties that seem like they should receive a Lake Wise Award can be referred to VT DEC's Lake Shoreland Coordinator for assessment.

Lake Wise is a non-regulatory assessment program for landowners who want to voluntarily improve the way stormwater moves across their property. An assessment is performed using the Lake Wise App which covers four areas for stormwater management – driveway, structures & septic, recreation area, shoreland. Landowners that can achieve high marks in each assessment area can earn the Lake Wise Award. Lake Wise Assessments must be performed using the Lake Wise App and must be done by trained Lake Wise Assessors. Trainings for Lake Wise are held every spring. If you cannot attend a training, please contact VT DEC Lakes and Ponds Lake Shoreland Coordinator.

More info about Lake Wise can be found here.

Road Surveys

Under the Municipal Roads General Permit, towns have been conducting the Road Erosion Inventory to identify and prioritize road problem areas. This data is available from the Agency of Natural Resources website and searchable by each town. Visit this site to learn what is known about the public road conditions in the Lake's watershed. When beginning the public road surveys for the LWAP, first consult the current road data available for the watershed. This will help guide what areas need further assessment.

In the LWAP, roads can be categorized by Agency of Transportation class and defined by length per class and percentage of watershed road length. Existing town plans, road erosion assessments, bridge & culvert assessments, VTDEC hydrologically connected road segment data, LiDAR data, and local stormwater infrastructure mapping can all be used to identify areas of high sedimentation and nutrient loading due

to road, embankment, and ditch erosion, undersized culverts, or heavy amounts of stormwater runoff. Road assessments and subsequent project recommendations can be done with the goal of aiding the Town Roads Department to proactively stabilize roads and maintain any existing stormwater management features to avoid future stormwater problems and possibly even come into compliance with the VTANR Municipal Roads General Permit. Many towns or counties will also have road erosion reports available online that may set forth current conditions and implementation plans that can be useful to you.

Use the ANR Atlas layer for Road Erosion Scoring (MRGP) to view the roads within the watershed of interest. This will allow you to see what segments of roads meet, partially meet, and do not meet the standards for road erosion. You will want to use this information to focus on sections of roads in the watershed that do not meet or only partially meet the standards. You will also want to view the Hydrologically Connected Road Segments data layer to view hydrological connection and use this to prioritize road segments for field evaluation.

Private roads are also often a concern around lakes. Private roads are not monitored under the MGRP. You will want to utilize the local knowledge of your LWAP team to decide if there are points of concern on private roads and reach out to the landowner(s) to see if they are amenable to assessments taking place and potential improvements being suggested. If owners are amenable, please include private roads in your road survey.

Once you have prioritized road sections using available online data and cross referencing that with any local knowledge from your LWAP team, you will perform field assessments of problem road segments. Visit each site and evaluate it for erosion issues, flagging any potential remediation projects for call out in the road assessment report. You can view all assessment data for each town here.

Visit the MRGP page for full information on road erosion inventory information for public roads:

Stream Assessments

Stream assessments are used to determine if the lake's tributaries are well protected, healthy, and not contributing sediment and phosphorus to the lake. Stream Geomorphic Assessment (SGA) Lite (VT DEC Phase 2 – Rapid Stream Assessment Protocol) should be performed on teach tributary of the lake. Specific segments (reaches) can be prioritized depending on local knowledge, current land use, and prior assessment. SGA's can reveal erosive conditions of stream banks and can indicate areas that could lead to flooding issues.

If appropriate, the SGA can be followed up with Steam Wise Assessments. Stream Wise Assessments focus on riparian area health and require outreach to and collaboration with landowners. Stream Wise is a newly launched initiative (2021) designed to inform and engage streamside landowners in protecting and planting native vegetated buffers on their properties to increase stream health, wildlife habitats, and flood resiliency in their local communities. Modelled after the Lake Wise Program's approach, Stream Wise Assessments lead to solutions for problems identified along riparian areas and inspire riparian homeowners to manage their property using watershed-friendly best management practices. Stream Wise Assessment Tools can be found on the Stream Wise Champlain website.

During the SGA, sections of streams can be prioritized for landowner outreach and Steam Wise assessments on those sections can be done as a part of the LWAP.

Other Potential Large Scale Land Uses for Field Assessment
Trail Systems, Timber Stands, Farming Operations, Wastewater Treatment Plants, Large Resort Areas, Interstates, or Concentrated Downtown Areas may need separate assessments and/or additional Stormwater Master Planning efforts. Large scale "other" land uses in the watershed that need further investigation and assessment should be noted as such in the Final Report.

5. Prioritizing Projects

Prioritization Process

Each LWAP may use a slightly different formula to prioritize the projects. Reviewing completed LWAPs for how this has been done for other lakes will help in deciding the best and most relevant criteria to use to rank projects. Other references for creating the prioritization process may include the Clean Water Initiative Program's worksheet on "Unified Scoring Prioritization for Stormwater Master Plans.". Another example of a ranking system created for a specific waterbody is the Watershed Consulting Stormwater Master Plan for Berlin which shows a ranking system for prioritizing projects based on pollution load reduction and costs.

In general, the project prioritization process should, using field data points collected with GPS during the assessments, identify key characteristics for each site driving increased storm-water runoff and pollutant loading. These GIS observations, along with field-based observations of site characteristics, can be summarized in a project prioritization table. Factors such as the potential for project to improve water quality, potential to reduce environmental impact, project feasibility, cobenefits, estimated project cost, and phosphorus removal efficiency ($/pound of phosphorus) should also influence project prioritization. Some LWAPs have used the Unified Scoring Prioritization for Stormwater Master Plans document developed by VTDEC to guide project prioritization efforts and have adapted this approach to meet the specific needs of a lake watershed. You may also wish to reference the CWIP program design guidance.

Below are some suggestions of criteria to use for prioritizing projects and for example, assigning them a value from 1-5, with 5 as the highest ranking, then summing the criteria together for final scores.

- Enhances Natural Buffers
- Phosphorus Loading
- Sediment Loading
- Wildlife Benefits
- Project Feasibility
- Maintenance Requirements
- Location (access)
- Hydrological Connectivity
- Public Demonstration Site
- Protects Other Restoration Efforts
- Landowner Support
- Constructability
- Costs, including BMP unit costs & adjustments
- Water Quality Benefits (sediment & nutrient reduction effectiveness)

Problem areas identified during field tours of the study area can be assigned numerical scoring metrics that are weighted to assist in prioritizing each project based on water quality benefits, project feasibility,

maintenance requirements, costs, and any additional benefits. Once a prioritization approach is determined, potential projects can be scored based on the defined evaluation criteria and grouped into categories (e.g., high, medium, and low priority). For high priority projects, selected based on defined prioritization categories, summary sheets can be developed that can be used to obtain input from project stakeholders during subsequent meetings to discuss and refine the final project prioritization list. Additionally, and as mentioned in Objective #3 on page four of this document, the LWAP should provide an estimate of relative sediment and phosphorus load from each of the three primary "sectors" of a lake's watershed (shoreland, streams, and roads) into the lake. Based on the distribution of project types, as well as each project's watershed location, size, and existing nutrient/sediment load, one can estimate the relative load from each of the three primary "sectors" of the lake watershed into the lake. This loading estimate will facilitate project prioritization efforts and ensure that the appropriate focus is being placed on addressing primary sources of sediment and nutrient loading to a given lake.

Conceptual Designs

Once project stakeholders have reviewed and agreed on a ranking for the various projects identified and described in the draft LWAP, the number of projects identified in your contract should be chosen for conceptual design development (30% design). Concept designs typically include the following elements:

- A site plan with contours, existing stormwater infrastructure, and proposed design elements
- Where relevant, hydrologic and hydraulic modeling data of the contributing drainage area and proposed BMP sizing and design specifications
- Typical details for proposed practices
- A preliminary cost opinion

6. Problems and Solutions

Problem Overview

LWAP's are an assessment tool used to identify problem areas in a lake watershed when it comes to stormwater runoff, erosion, and pollution into the lake. The field assessments result in a list of projects that can address these problems. Understanding the problems and the potential solutions to those problems is key to producing an effective LWAP report.

Lake water quality and ecological functions and values are impacted by land uses on the immediate shoreland and further into the watershed. Lakes are best protected from natural shorelands. Some of the most affordable solutions to mitigating stormwater issues are changing cultural habits from clearing and planting lawn to the use of native plantings in swales, berms, raingardens, no-mow zones and for increasing buffer width along the water's edge.

Messaging to property owners should be specific on actions to take to protect the lake. In many situations, a property owner could mitigate stormwater runoff issues by reducing their lawn, reintroducing alternative vegetation types, or minimizing parking areas to lessen compaction and impervious surface sprawl. Solutions, especially project proposals, should not be designed to accommodate or mitigate land management practices that are not "lake-friendly," such as those commonly found in suburbanized landscapes. In these situations, there are often relatively

straightforward solutions, such as those mentioned above. Instead, solutions and more complex project proposals should focus on managing runoff at sites where there is no "easy" solution and where technical expertise and additional funding is needed, such as erosion associated with a failing culvert or large amounts of runoff associated with a public parking area. In most cases, clearing shorelands leads to bank instability and erosive slope runoff. While hardscapes or seawalls may temporarily stabilize shorelands, they do not provide the benefits of natural shoreland vegetation: wildlife / pollinator habitat, wave and flood protection, temperature moderation, sediment attenuation, and filtration of stormwater runoff. Restoring natural shoreland communities by vegetation plantings is often the most affordable / best solution for restoring a healthy lake ecosystem.

Understanding land use in the watershed and identifying possible point and non-point sources of nutrients and sediment carried via tributaries and stormwater runoff from roads into a lake is an important element of a LWAP's assessment process. This process can lead to the identification of best management practices or projects to reduce nutrient loading, particularly in watersheds that are scored to be disturbed or highly disturbed under the VT Lake Scorecard. Additionally, understanding the conditions of streams and any contribution of sediment from streambank erosion into a lake, particularly during intense precipitation events, is an important part of the LWAP problem / solution identification process. Specific problems and solutions for stream and road sectors of the LWAP will be included in future versions of these Technical Guidelines.

Vegetative swale with rock check dam treats 98% of road runoff to lake

Shoreland Best Management Practices

Shoreland Best Management Practices (BMPs) are designed for minimal disturbance of the shore for maximum efficiency to soak up stormwater and protect wildlife habitat. Often the preferred BMP for lake protection is a vegetated buffer, due to the effectiveness of vegetation at preventing erosion, its added wildlife habitat benefit, and cost. Other times structural enhancement is needed or a combination of vegetative and structural management practices. The Lake Wise Shoreland Best Management Practices include both vegetative and structural treatments and can be found on the Lake Wise web site.

Green Stormwater Infrastructure Practices

Green Stormwater Infrastructure is a suite of "systems and practices that restore and maintain natural hydrologic processes in order to reduce the volume and water quality impacts of stormwater runoff." Riparian buffers, green roofs, bioswales, cisterns, permeable pavements and constructed wetlands are all examples of GSI. More information is available on the GSI Website.

Bioengineering Designs and Solutions

Sometimes, erosion problems on lakeshore properties are so advanced that bioengineering practices are needed in order to return the lakeshore to a healthy state.

The Vermont Bioengineering Manual lists many shoreland best management practices and bioengineering practices in detail that can be used to enhance and remediate shorelines. All projects identified in the LWAP that will apply for further funding through the Clean Water Initiative Program will be projects that utilize solutions listed in the bioengineering manual or that have prior approval from DEC Lakes and Ponds staff.

Lake Shore Permitting

To learn about what permits may be required for certain Best Management Projects, visit the Shoreland Permitting web site. Also, learn who the regional Permitting Specialist is for each lake.

On the next page is an example from the Bioengineering Manual of common upland best management practices and shoreland bioengineering practices. These are just some examples, there are many more innovative and effective strategies listed in the bioengineering manual. Lake Wise also has many useful factsheet covering how to create and install some of these best management practices.

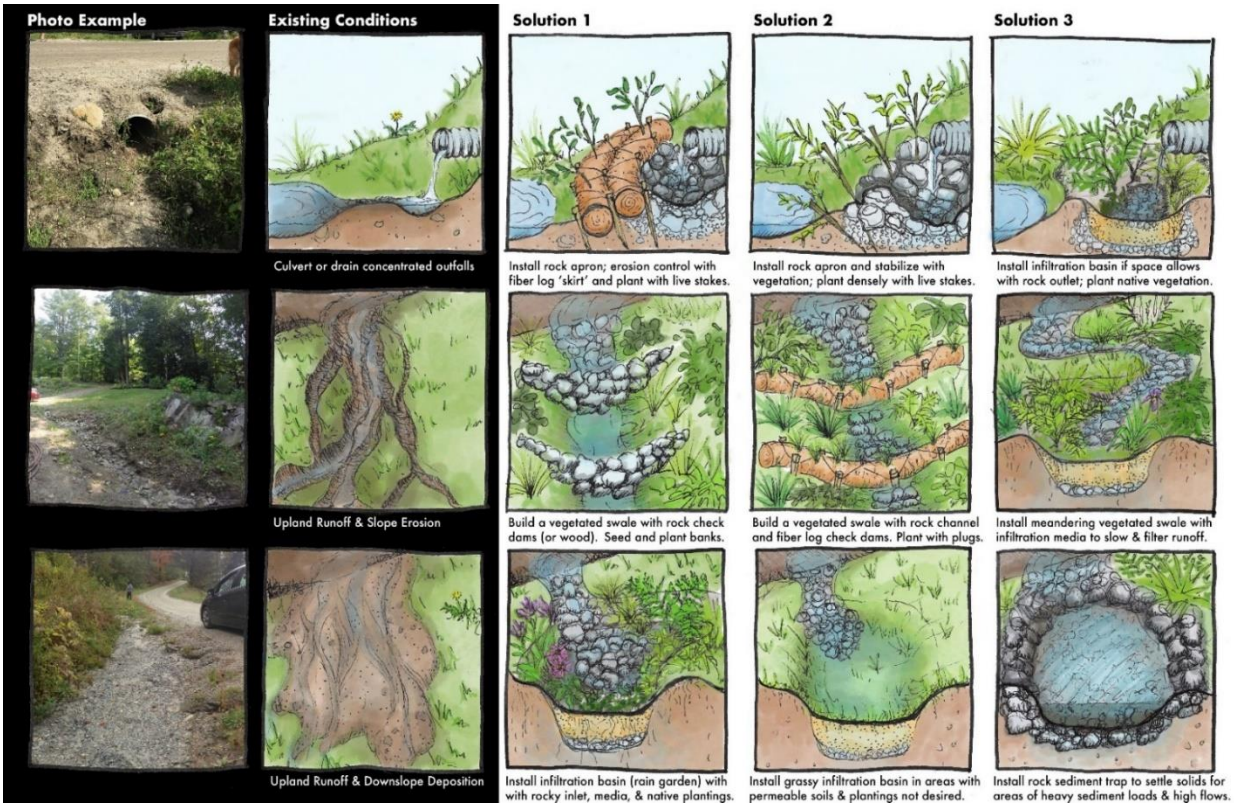
Permitting

Some shoreland projects will require a permit to be implemented. The two most common types of permits are Shoreland Permits and Lake Encroachment Permits. To discuss permitting for your projects, please visit the Shoreland Permitting website and speak with your regional permitting specialist.

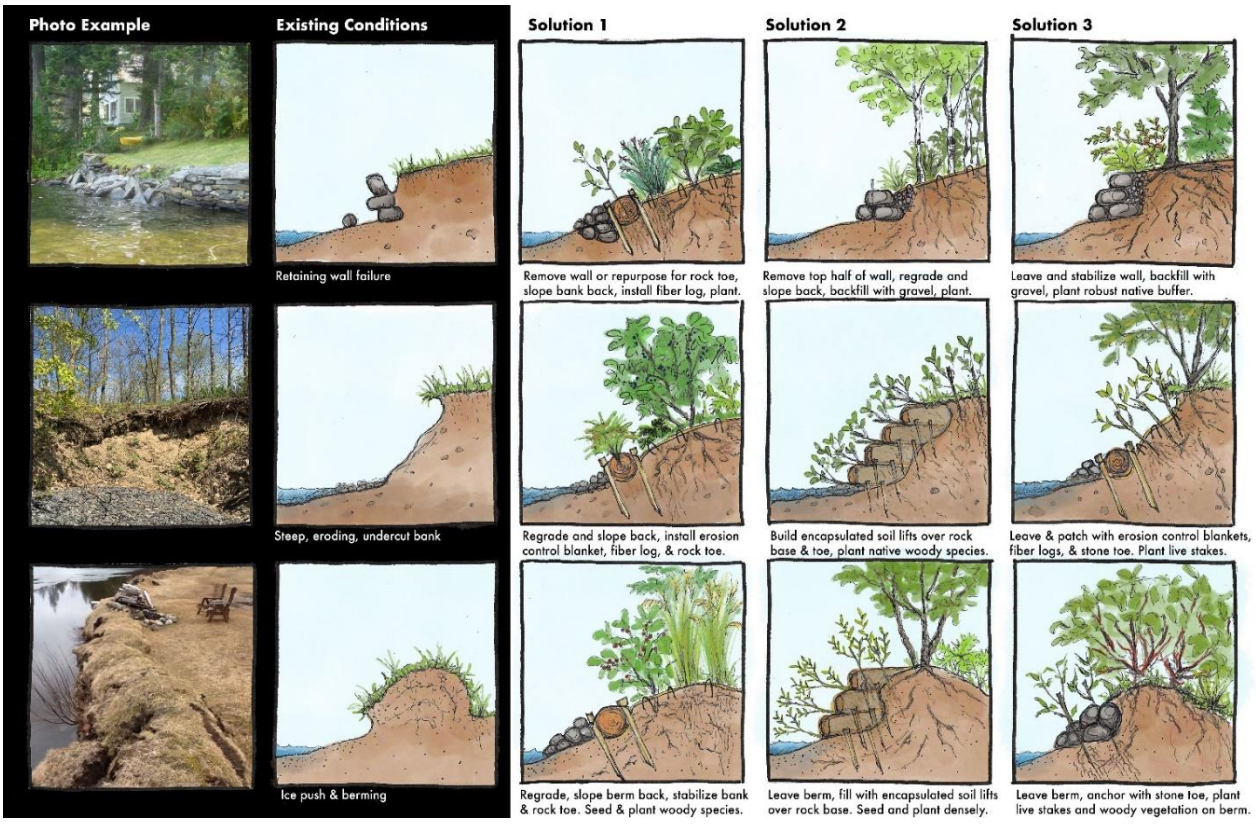
Lake Encroachment - Projects encroaching on public waters (from mean water level towards the lake) such as docks, walls, boathouses, bridges, water intakes, cables, dredging, or fill requires a permit. Lake Encroachment Permits are issued under 29 V.S.A. Chapter 11.

Shoreland - As of July 1, 2014, changes to land use within 250 feet of a lake's mean water level (also known as the Protected Shoreland Area), such as any new development, redevelopment, or vegetation removal, may require a permit. Shoreland Permits are issued under 10 V.S.A Chapter 49A, Subsections 1441–1449.

Upland Shoreland Solutions - *Fall 2021 Vermont Bioengineering Guide, by Watershed Consultants, Nectar Design, and Holly Greenleaf*



Shoreline Bioengineering - *Fall 2021 Vermont Bioengineering Guide, by Watershed Consultants, Nectar Design, and Holly Greenleaf*



7. Information Sources

Vermont Water Quality Standards
https://dec.vermont.gov/sites/dec/files/documents/wsmd_water_quality_standards_2016.pdf
Vermont Lakes and Ponds Web Site
https://dec.vermont.gov/watershed/lakes-ponds
Vermont Water Quality Monitoring
https://dec.vermont.gov/watershed/map/monitor#River%20Programs
Vermont Tactical Basin Planning
https://dec.vermont.gov/water-investment/watershed-planning
Shoreland Permitting
https://dec.vermont.gov/watershed/lakes-ponds/permit
The Natural Shoreland Erosion Control Certification Course and Bioengineering Information
https://dec.vermont.gov/watershed/lakes-ponds/lakeshores-lake-wise/nsecc
Vermont Lake Wise and Shoreland BMPs
https://dec.vermont.gov/watershed/lakes-ponds/lakeshores-lake-wise
Vermont Green Stormwater Infrastructure
https://dec.vermont.gov/water-investment/cwi/solutions/developed-lands/green-infrastructure
Vermont Clean Water Initiative Program Grant Opportunities
https://dec.vermont.gov/water-investment/cwi/grants/opportunities
Vermont Clean Water Initiative Program Funding Policy
https://dec.vermont.gov/sites/dec/files/wsm/erp/docs/2021-02-04_FINAL_FY21_CWIPFundingPolicy_signed.pdf
Agency of Natural Resources Atlas
https://anr.vermont.gov/maps/nr-atlas
UVM Spatial Analysis Lab
https://site.uvm.edu/sal/
NRCD Soils
https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx
Lake and Watershed 0.5 Meter Impervious Surface Data
https://anrmaps.vermont.gov/websites/Documents/DEC_LakesLandcover/
Municipal Roads Program and the Road Erosion Inventory Town Data
https://dec.vermont.gov/watershed/stormwater/permit-information-applications-fees/municipal-roads-program
Vermont Bridge and Culvert Data
https://www.vtculverts.org/
Watershed Management Division
https://dec.vermont.gov/watershed
Vermont Agency of Natural Resources
https://anr.vermont.gov/
Federation of Vermont Lakes and Ponds
https://vermontlakes.org/
Lake Champlain Basin Program
https://www.lcbp.org/